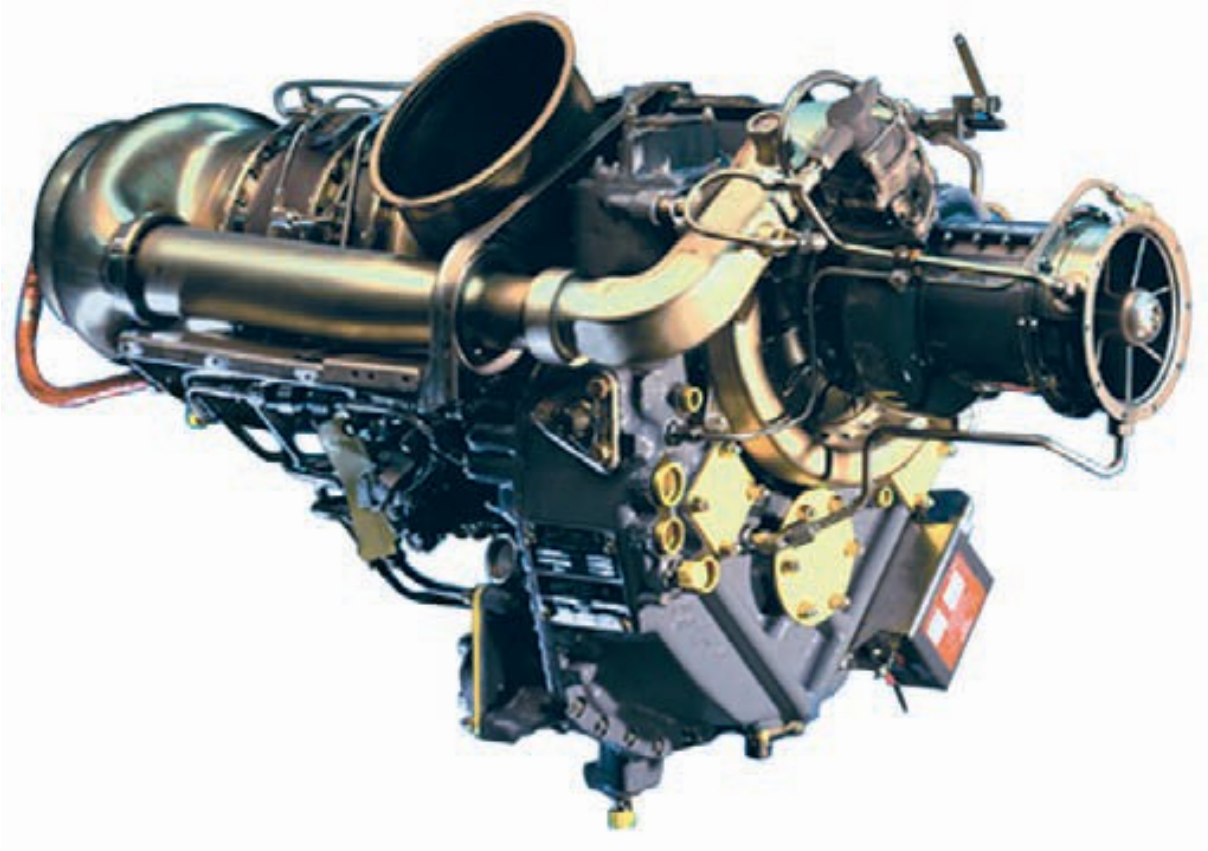
250-C20J Engine System



Six -axial and one -centrifugal-stage compressor,

single combustion chamber,

two-stage gas-producer turbine,

and a two-stage power turbine.

NATOPS

Subassemblies

Four Subassemblies:

1. Compressor section
2. Combustion section
3. Turbine section
4. Accessory gearbox section

Compressor Section

Four subassemblies of the compressor:

1. Front Support
   7 hollow struts (inlet guide and anti-ice)
2. Compressor rotor blades and wheels
   Rotors (accelerate airflow)
   Stators (increase static pressure)
   compressed to 6.5 times / 500 F
3. Case assemblies
   5th Stage Bleed Air Valve
   unloads the compressor at low pressure ratio
4. Diffuser scroll
   Anti-icing / cabin heat
   compressor discharge air pressure is sensed by the fuel contol system

Combustion / Turbine Section

75% of the air going to the combustion chamber is used for cooling.

2/3 of the energy leaving the combustion section drives the compressor section and Ng drive train.

.25 x .333 = 0.083% drives the Nf

Accessory Gearbox

Gas-producer Turbine drive train:

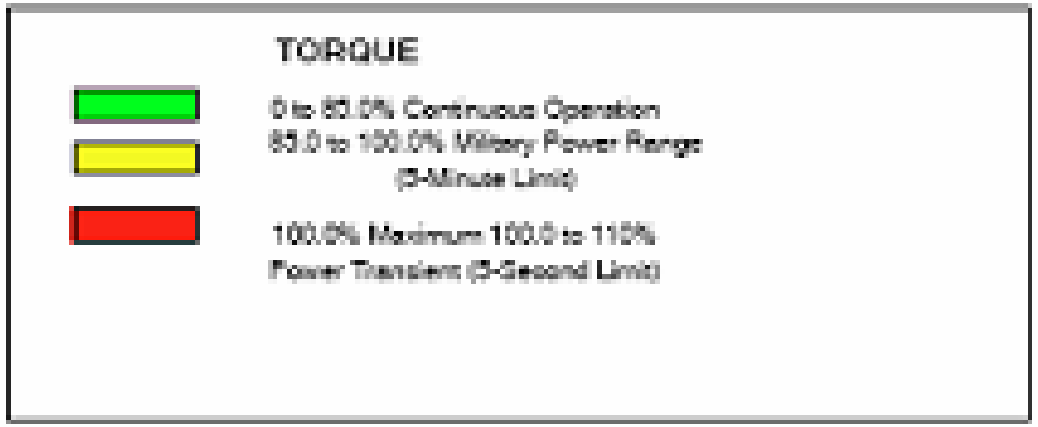
- S – Starter-generator
- T - Tachometer-generator
- O – Oil Pump
- F – Fuel Control
- F – Fuel Pump
- S – Standby Generator ©

Accessory Gearbox

Free-producer Turbine drive train:

- G – governor (Nf)
- O – Output shaft (Power)
- T – Tachometer-Generator (Nf)
- T – Torquemeter

250-C20J is capable of developing 420 SHP, but is limited to 317 SHP because of drive train limitations.



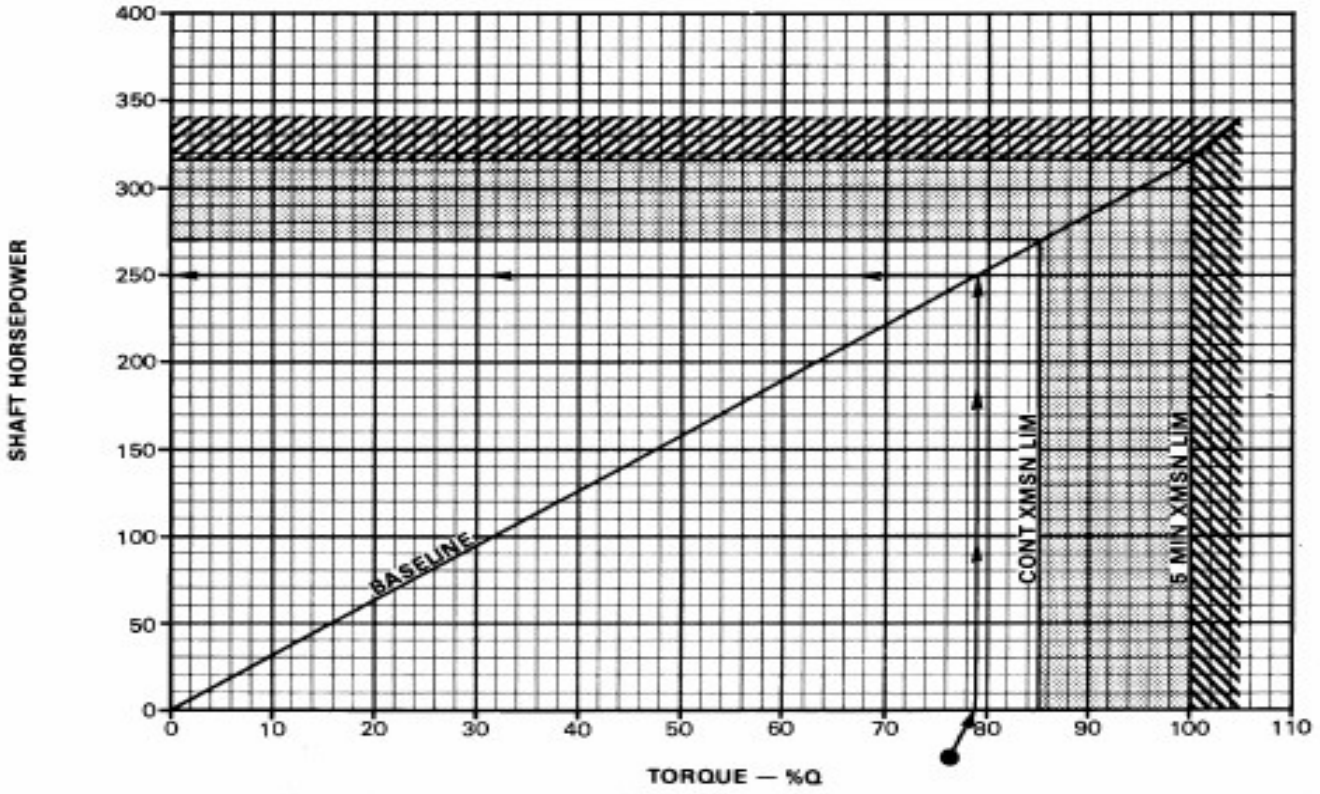
SHAFT HORSEPOWER VS TORQUE

SHP VS TORQUE TH-57

100% ENGINE RPM

EXAMPLE:

WANTED
SHAFT HORSEPOWER EQUIVALENT
KNOWN
79% TORQUE
METHOD
ENTER TORQUE SCALE HERE ●
MOVE UP TO BASELINE
MOVE LEFT AND READ 250 SHAFT HORSEPOWER



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR AIRCRAFT

SHAFT HORSEPOWER VS TORQUE

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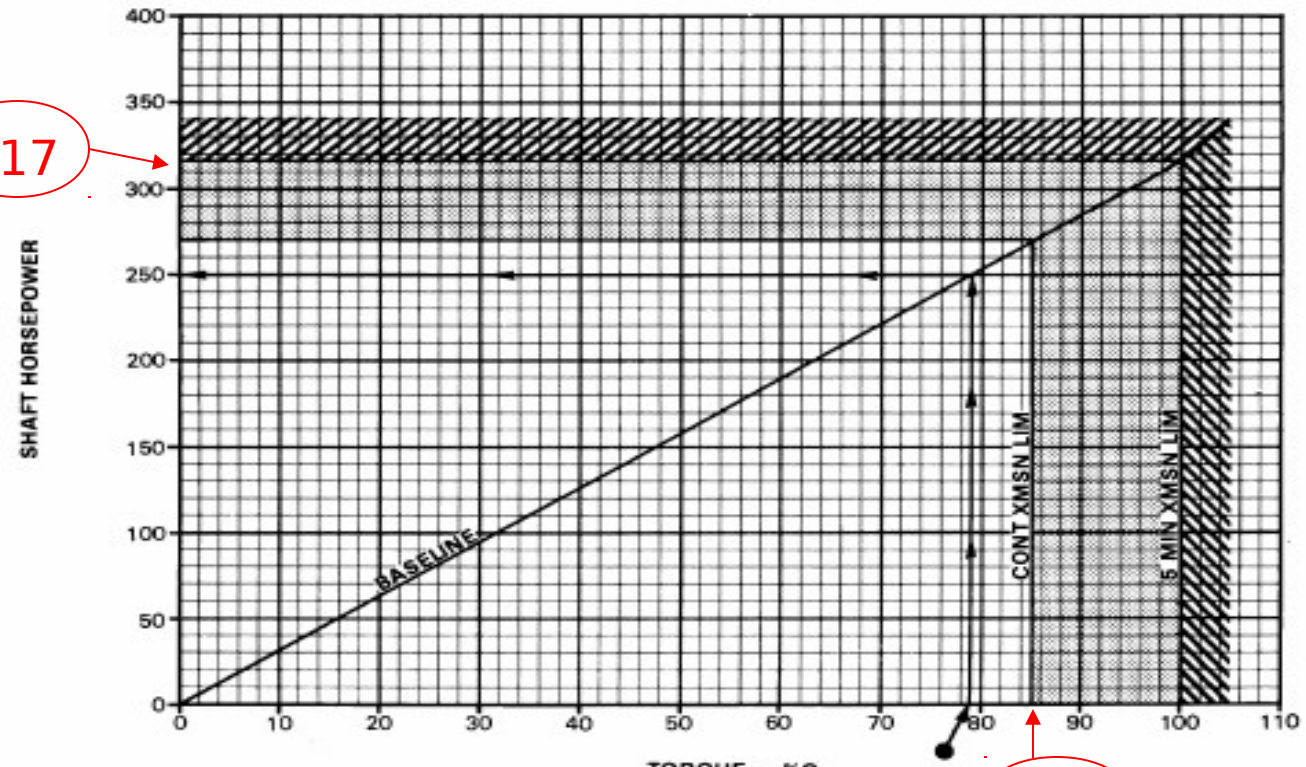


DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR AIRCRAFT

Fuel Control

Fuel control system consists of:

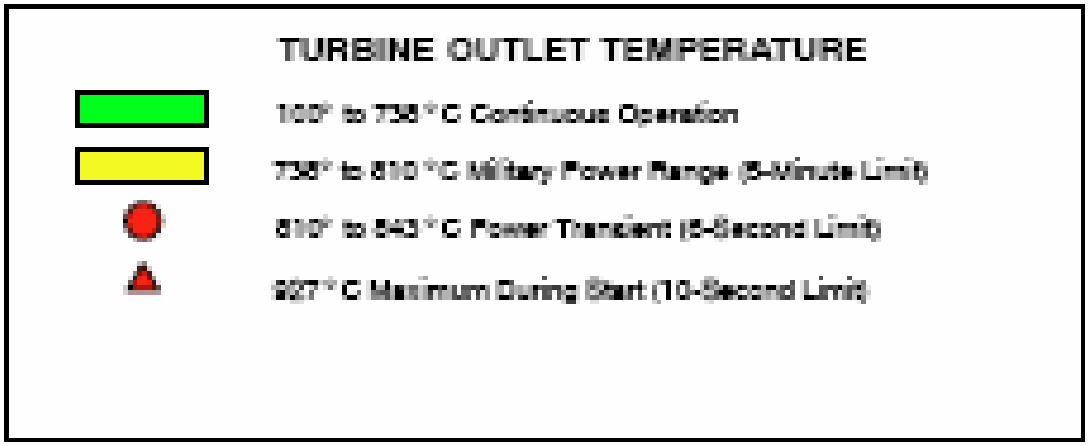
- Ng fuel control unit
- Nf governor

Pneumatic mechanical type system

Incorrect fuel metering may result in:

Excessive temperature, compressor stall, compressor surge, rich or lean blowout.

Excessive temp?


TURBINE OUTLET TEMPERATURE
100° to 738°C Continuous Operation
738° to 810°C Military Power Range (5-Minute Limit)
810° to 843°C Power Transient (5-Second Limit)
927°C Maximum During Start (10-Second Limit)

TOT	TOT light flashes once per second within transient range.	Adjust collective as required to remain within limits.
	TOT light flashes twice per second when limit is exceeded.	Land as soon as possible.

Note

TOT light will extinguish once out of transient and exceedence ranges. Digital readout will continue to flash twice per second if limit is exceeded.

14.9 COMPRESSOR STALL

Indications:

Popping or rumbling noise.

Vibrations.

Rapid rise in TOT.

N_g fluctuation.

Loss of power.

WARNING

Be prepared for complete power loss.

Procedures: SEE IC # 13

*1. Collective — Reduce

Note

Slight power (collective) reduction will often eliminate compressor stalls.

*2. ENG Anti-ice switch — OFF.

*3. Cabin Heat Valve — OFF.

*4. Land as soon as possible.

WARNING

When accelerating the rotor system during the initial rotor engagement or after power off maneuvers, exceeding 40 percent torque may induce compressor stall or engine chugging.

Note

Mild compressor stalls may occur that will allow powered flight if TOT is within operating limits.

Fuel Control

Factors involved in regulating fuel flow are:

1. Twist grip position
2. Compressor discharge air pressure
3. Ng speed
4. Nf speed

Fuel Control

Factors involved in regulating fuel flow are:

Twist grip position

- Closed – cutoff valve prevents fuel flow
- Flight Idle – fuel is metered for starting via compressor discharge air pressure
- Full Open – FCU reacts to Nf governor signals

Fuel Control

Factors involved in regulating fuel flow are:

Compressor discharge air pressure

In the flight idle position fuel is metered for starting in response to compressor discharge air pressure.

Fuel Control

Factors involved in regulating fuel flow are:

Ng speed

Idle RPM is stabilized; through the control of air pressure within the FCU, by a flyweight assembly, driven by the Ng gear train.

Fuel Control

Factors involved in regulating fuel flow are:

Nf governor

With twist grip full open, the Nf governor varies the air pressure signals to the fuel control unit through the operation of its internal flyweights, which are driven by the Nf gear train.

Fuel Control

In short:

The fuel control system controls engine power output (Nf) by controlling Ng speed with fuel flow.

13.2 ABORT START

The Abort Start procedure is intended for use when any abnormalities are encountered during the start sequence. Abnormal starts may be, but are not limited to, the following categories:

1. An igniter failure is indicated when:

   a. TOT fails to rise after twist grip rotated to flight idle.

   b. N_g fails to rise above 20 percent.

2. A hung start is indicated when:

   a. N_g rises slowly and stabilizes.

   b. TOT rises more slowly than normal.

3. A hot start is indicated when:

   a. TOT exceeds limits.

   b. TOT caution light and digital display flash twice per second.

Note

An excessive rise in TOT, TOT rapidly accelerating through 840 °C, and/or the battery voltage stabilized below 17 volts on starter management, particularly when combined, indicates an increased potential for a hot start and may necessitate aborting the start to preclude an overtemp.

In the event of a mechanical failure in the engine or control linkage, the twist grip may not secure fuel flow to the engine. Turning the fuel valve off will provide the only means of securing fuel flow if the twist grip fails to control TOT.

Note

If a subsequent start is attempted, utilize an APU.

Procedures:

*1. Twist grip — Close.

*2. Fuel valve — As required.

*3. Starter — Secure after TOT stabilizes at 400 °C or below.

*4. Battery switch —As required.

Model 250 quick reference starting problems

Engine fails to reach 15%
- Inadequate Q at starter pad (weak batt)
- Binding Ng

Engine fails to light off
- Faulty circuit to ignition unit
- Faulty ignition exciter or spark igniter
- Fuel nozzle shimmed incorrectly
- Water or other contaminant in fuel
- Fuel nozzle orifice clogged

Model 250 quick reference starting problems

Engine lights off but will not accelerate to idle speed at normal rate:

Improper pneumatic signal to gas producer fuel control

Inadequate torque at starter pad (battery)

Faulty fuel nozzle

Model 250 quick reference starting problems

High TOT during start:

Insufficient time allowed for fuel to drain after an unsuccessful starting attempt

High residual TOT in excess of 150

Excessive compressor air leakage

Gas producer fuel control incorrectly adjusted or calibration has shifted

Model 250 quick reference starting problems

Acceleration or low TOT during starting:

Fuel control system air sensing lines leaking

Gas producer fuel control incorrectly adjusted

or calibration has shifted.

GOV RPM

Movement of the collective pitch lever results in a movement of [redacted] nor lever mounted on the left side of the engine.

Used to provid[redacted]tion

GOV RPM is used to set Nf betwe[redacted] [redacted] +/-0.5

Droop Compensation

Droop compensation is accomplished by changing [redacted]essure signal to the fuel control in anticipation of the change in engine load.

14.6 ENGINE OVERSPEED (N_g) ROTOR RPM (N_r)

Indications:

N_r increase.

N_g increase.

N_g increase.

TOT increase.

Right yaw.

Engine noise increase.

Procedures:

+1. Collective — Adjust as required to maintain N_r in operating range.

+2. Twist grip — Reduce (to maintain N_g in operating range).

Note

The N_g overspeed must be controlled by continually coordinating collective and twist grip.

+3. Collective/twist grip — Readjust.

+4. Land as soon as possible.

14.7 UNDERSPEEDING N_p/N_r

Indications:

Low N_r.

Low N_g.

Procedures:

+1. Collective — Adjust as required to maintain N_r in operating range.

+2. Twist grip — Full open.

+3. GOV RPM — Full increase.

+4. Check power available with N_r in limits.

Note

Power available is considered to be sufficient if level flight can be maintained with N_r at 90 percent or higher. Do not decelerate below 50 KIAS (minimum power airspeed) while executing a power check.

If power is not sufficient:

*5. Autorotate.

Note

If some usable power exists but level flight cannot be maintained, that power, if sufficient, may be utilized to effect a landing or minimize rate of descent en route to a more suitable site for autorotation. Terrain permitting, a sliding landing provides the lowest power available.

If sufficient power is available:

*6. Land as soon as possible.

14.8 FUEL CONTROL FAILURE

Indications:

Erratic N_g.

Fluctuating N_g and/or TOT.

Procedures:

+1. Collective — Adjust as required to maintain N_r in operating range.

+2. Twist grip — Adjust (to maintain N_r/N_g in operating range).

+3. Land as soon as possible.

WARNING

Be prepared for complete power loss.

Eng Failure Warning System

ENG OUT warning light

- Ng drops below 55+/- 3 percent
- Beeping audio tone

ROTOR LOW RPM warning light

- Nr drops below 90+/- 3 percent
- Steady audio tone

[redacted]

14.1.2 Engine Failure in Flight

In the event of an engine failure in flight, a safe landing can be accomplished, provided that altitude and airspeed combination is within safe limits and altitude is sufficient to permit selection of a suitable landing area. Consideration should be given to an engine restart in flight.

Procedures:

1. Autorotate.
2. Shoulder harness — Lock.

If time and altitude permit:

3. Mayday — Transmit on guard.
4. Transponder — Emergency.

[redacted]

14.28.1 N_g Tachometer or Turbine Outlet Temperature System

If N_g or TOT fails to zero or fails to rise and fall with corresponding power changes:

1. Monitor other engine instruments.
2. Avoid high power settings.
3. Land as soon as practical.

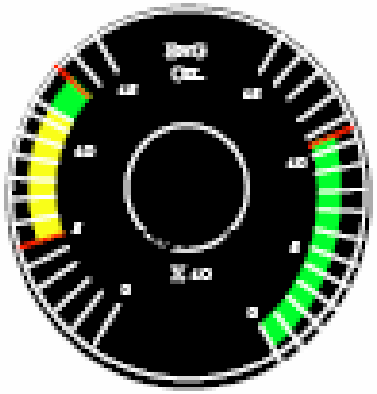
Note

Failure of the N_g tachometer generator is usually accompanied by actuation of the ENG OUT warning horn and caution light.

14.28.5 N_r and N_f Tachometer Malfunction

If the tachometer indications fluctuate erratically or peg and all other instruments and lights are normal, land as soon as practical, utilizing the remaining engine and performance instruments to monitor flight performance.

Engine Oil System

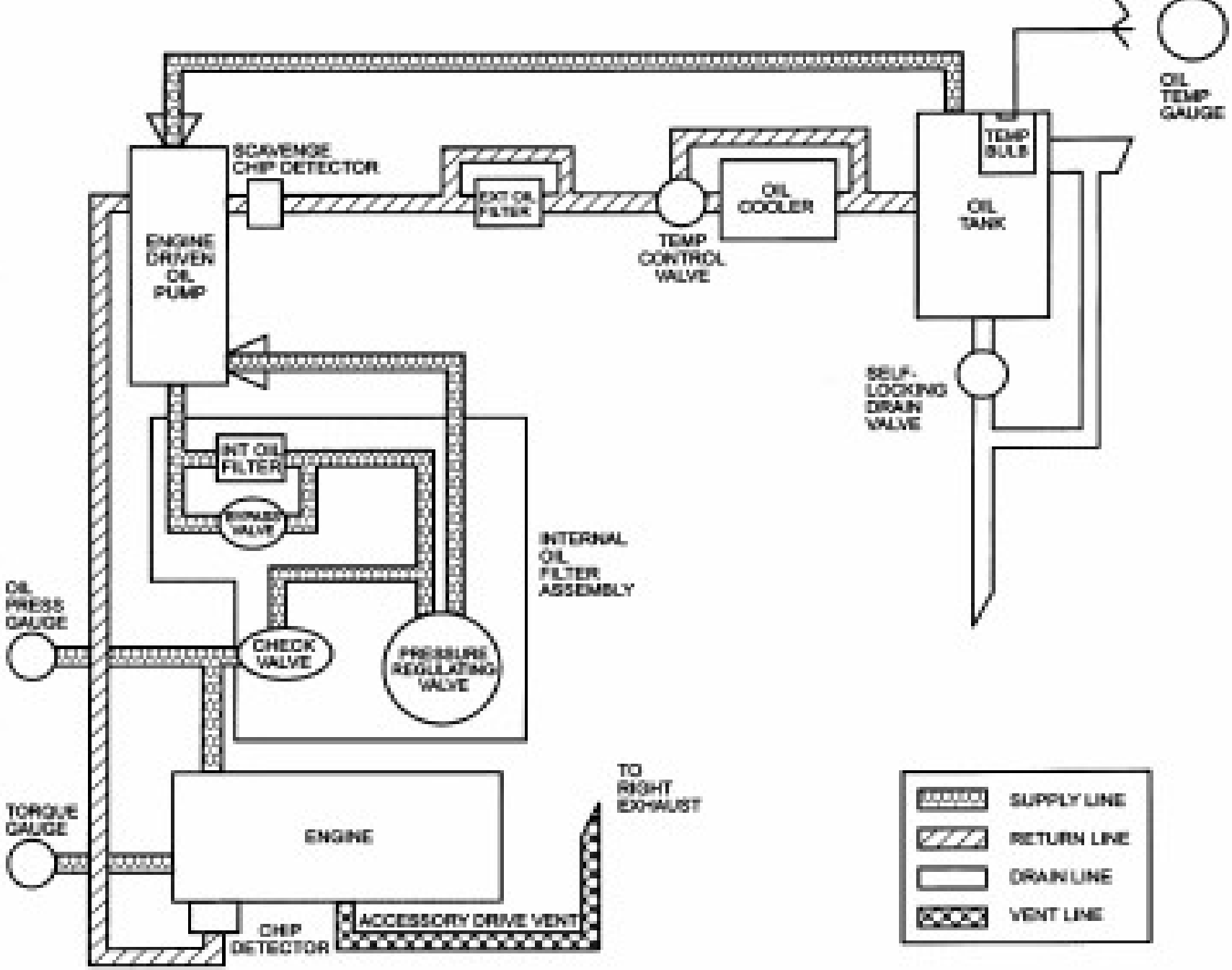


ENGINE OIL TEMPERATURE

- 0° TO 107 °C Continuous Operation
- 107 °C Maximum

ENGINE OIL PRESSURE

- 30 PSI Minimum Below 78% N_2
- 80 PSI Minimum for 79 to 84% N_2
- 115 PSI Minimum Above 84% N_2 (Double Wide Arc)
- 30 PSI Minimum, 130 PSI Maximum


OIL TEMP GAUGE
TEMP BULB
SCAVENGE CHIP DETECTOR
EXT OIL FILTER
OIL COOLER
OIL TANK
ENGINE DRIVEN OIL PUMP
TEMP CONTROL VALVE
SELF-LOCKING DRAIN VALVE
INT OIL FILTER
BYPASS VALVE
INTERNAL OIL FILTER ASSEMBLY
OIL PRESS GAUGE
CHECK VALVE
PRESSURE REGULATING VALVE
TO RIGHT EXHAUST
TORQUE GAUGE
ENGINE
CHIP DETECTOR
ACCESSORY DRIVE VENT
SUPPLY LINE
RETURN LINE
DRAIN LINE
VENT LINE

Oil tank reservoir

5.5 quart capacity

Overfull reading on the dipstick indicates a seal failure between the freewheeling unit and the engine oil system.

Servicing

	STANDARD	ALTERNATE
OIL		
ENGINE	AEROSHELL 560	MOBIL JET OIL 254 or 291 EXXON ETO 2197

WARNING

AEROSHELL 560 is the primary oil for the engine. If any other oil is added, flight time is limited to 5 hours because of the tendency of the oils to create sludge resulting in bearing failure. Prior to adding alternate oil, maintenance shall be consulted and a VIDS/MAF shall be initiated. Alternate oil may be mixed in the transmission with no flight time limit; however, a VIDS/MAF shall be initiated upon return to home field.